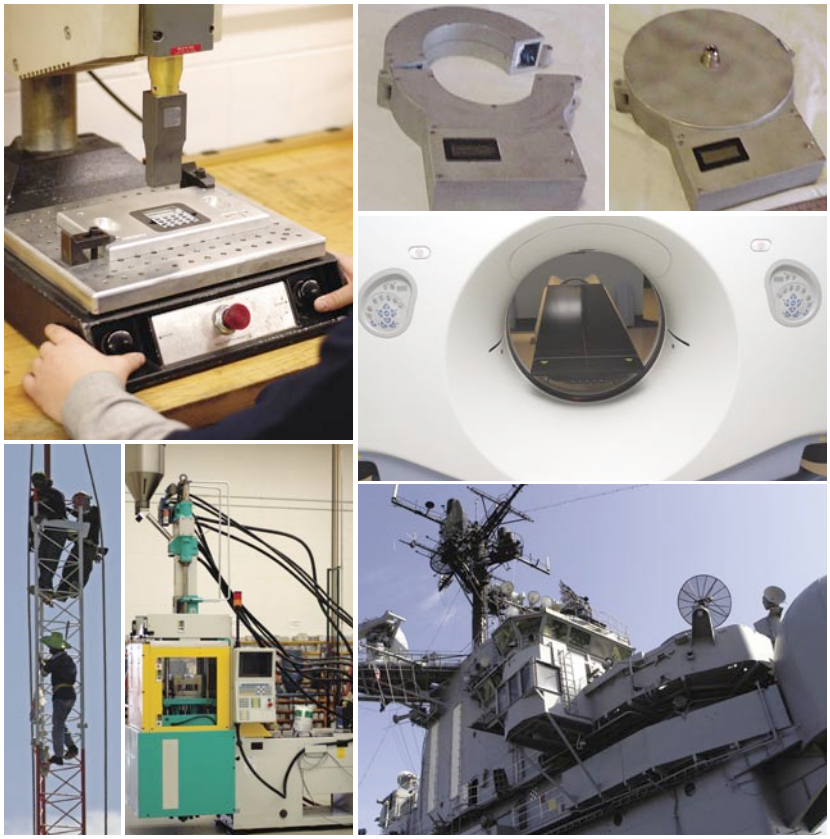
sensors and detectors

Low-Cost, Accurate Monitor of RF-Induced Currents

... a better method of assuring workers of their safety



NASA Goddard Space Flight Center invites companies to license this patented, wearable device that provides a superior means for monitoring radio frequency (RF)-induced currents in the body. The device consists of a probe with a nonferrous core, making it lightweight, flexible, and more accurate than ferrous-core devices. The probe is coupled with a specialized transimpedance amplifier circuit that allows for use over an extremely wide range—between 60 Hz and 110 MHz—accurately and without the need for recalibration. This technology provides the first low-cost, accurate means of directly measuring RF-induced currents in the body, thereby ensuring that individuals exposed to RF radiation remain within the safety standards. A specific absorption rate (SAR) may then be calculated using known dielectric properties of the human body.

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Benefits

This technology provides the first-ever practical means for directly measuring RF-induced currents, ensuring that individuals remain within the basic limits stipulated by international organizations:

- **Increased accuracy**: The device provides an accurate, high-resolution direct RF-current measurement over a broad frequency range. This eliminates the need for calibration for differing frequencies and the measurement errors that are induced when multiple frequencies are present.
- **Versatile**: The device provides constant sensitivity over a large usable bandwidth, and its design can be modified to allow product flexibility.
- **Lightweight**: Because the core of this device is nonferrous, it is significantly lighter than ferrous-core clamps and does not change the impedance of the object being measured.
- **Minimal product development cost**: A working prototype exists that has demonstrated a flat response over a frequency range of 300 kHz to 110 MHz.
- **Low cost**: The parts required to manufacture this device are inexpensive.

technology opportunity

Applications

This device is ideal for any situation involving exposure to RF radiation:

- **Plastics manufacturing**: The device can help ensure worker safety for operators of RF heat sealers, welders, ovens, and other equipment used in manufacturing a wide range of plastics and composite materials.
- **Broadcasting**: Personnel servicing AM and FM radio, VHF TV channels, and other specialized transmitters that are not shut off during maintenance can use this device.
- **Military**: Personnel in close proximity to powerful transmitters on ships or airplanes would benefit from this technology.
- **Antenna design**: Developers and testers of antenna designs can make measurements more easily using this technology.
- **Cancer treatment**: Individuals receiving RF-based hyperthermia treatments could use this technology to ensure that heating is not occurring in other parts of the body.

Technology Details

How it works

This technology includes a nonferrous current probe based on a conductive toroidal coil. When placed around the leg or other body member, the probe acts as a transformer. As RF-induced current in the body generates a magnetic field, the probe's magnetic pickup (Rogowsky) coil responds. The voltage induced on the coil is directly proportional to the time derivative of the magnet flux through the coil.

The coil is integrated with a wide-band transimpedance amplifier circuit with a design that keeps the sensitivity of the current probe substantially flat over a wide frequency range—60 Hz to 110 MHz. This frequency range makes the device useful with AM and FM transmitters as well as with RF heating equipment such as sealers, ovens, and welders (27.12 MHz).

Why it is better

This technology's innovative design offers several advantages. Because it does not affect the impedance of the body, does not introduce an additional antenna, and has a flat response over a broad frequency range, this device provides a more accurate measurement. This accurate measurement of RF-induced current in the body is particularly useful in applications where various frequencies may be present (e.g., harmonics)—a capability not presently available in similar products. Its nonferrous core is inexpensive, lightweight, and provides for flexibility in product design, allowing the development of devices that can be worn comfortably around the ankle, leg, arm, wrist, chest, neck, etc.

Beyond its design advantages, this device's ability to directly measure RF-induced currents in the human body makes practical and affordable a direct calculation of specific absorption rate. This offers advantages over the use of electromagnetic field (EMF) strengths to determine maximum permissible exposure (MPE) since EMF absorption is highly dependent upon variables as height, weight, body shape, and changing body position. Users of this device can accurately measure EMF-induced body currents as well as contact currents (recommended by IEEE Std. C95.1-1991). As a result, this device provides a low-cost means for companies with workers exposed to RF radiation to confirm unequivocally that employees are safe.

Patents

NASA Goddard has secured patent protection for this technology (U.S. Patent #6,566,854).

Licensing and Partnering Opportunities

This technology is part of NASA's Innovative Partnerships Program, which seeks to transfer technology into and out of NASA to benefit the space program and U.S. industry. NASA invites companies to consider licensing this technology (GSC-13985-1) for commercial applications.

For More Information

If you are interested in more information or want to pursue transfer of this technology (GSC-13985-1), please contact:

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